

EXHIBIT M



LC064N1
Liquid Crystal
Display

Product Specification

S **Specification**
For
APPROVAL

(☒) Preliminary Specification

(☐) Final Specification

Title	6.4" TFT LCD
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BUYER NAME	
MODEL NAME	

SUPPLIER	LG Electronics Inc.
MODEL NAME	LC064N1

SIGNATURE	DATE
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____

Please return 1 copy for our confirmation with your signature and comments.

APPROVED BY	DATE
_____ /G.Manager	_____
REVIEWED BY	
_____ /S.Engineer	_____
PREPARED BY	
_____ / Engineer	_____

Product Engineering Dept.
LCD Division LG Electronics Inc.



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Record of Revision

September. 12. 1997 October. 15. 1997 February. 15. 1998	Preliminary Ver. 1.0 Preliminary Ver. 1.01 Preliminary Ver. 1.02
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Table 1 ABSOLUTE MAXIMUM RATINGS

Parameter		symbol	Values		Units	Notes
			Min.	Max.		
DC power	Positive power	V_{EE}	-0.3	14.0	V	
Analog RGB	Composite video	V_{BS}		3.0	V_{p-p}	
	Analog RGB	V_{RI}, V_{GI}, V_{BI}	-0.3	5.3	V_{p-p}	
Digital signal		HSY, VSY, V_{SW}	-0.3	5.3	V	
Control signal		BRT, CNT, CLR, TNT	-0.3	4.7	V	
Operating Temperature		T_{OP}	0	50	°...	1)
Storage Temperature		T_{ST}	-20	60	°...	2)

Note : 1) Relative Humidity is 0 %

2) Under no condition should the unit be exposed to corrosive chemicals.

3. Electrical Specifications

The LC064N1 requires two power inputs. One is employed to power the LCD module and to derive the voltages that drive the TFT array and liquid crystal. The second input which powers the back-light CCFT, is typically generated by an inverter which is an external unit from the LCD.

Table 2 ELECTRICAL CHARACTERISTICS:

Parameter				Symbol	Values			Units	Impedance
					Min.	Typ.	Max.		
MODULE	DC Power	Positive power		V _{RR}	10.8	12.0	13.2	V	
	Analog signal	Composite video	Amplitude	V _{BS}	0.8	1.0	1.2	V _{p-p}	75•γ ¹⁾ >0.2 V _{p-p}
		Analog RGB	Amplitude	V _{RI} V _{GI} V _{BI}	-	0.7	2.0	V _{p-p}	>10k•γ
	Digital signal	Input	High	V _{SW}	3.5	-	5.0	V	>50k•γ
			Low		0.0	-	1.5	V	
		Output	High	HSY	3.5	-	5.0	V	>20k•γ
			Low	VSY	0.0	-	1.5	V	
	Power consumption				Pc	-	2.94	3.12	watts
BACK-LIGHT	Lamp Input voltage			V _{LI}	300	355	385-	V _{RMS}	
	Lamp Input current			I _{LI}	3	5	9	mA	
	Lamp kick-off Voltage			V _{LK}	-	-	860(0°).. 680(25°)..	V _{RMS}	
	Lamp operating Frequency			F _{BL}	35	55	80	kHz	
	Power consumption ²⁾			P _{BL}	1.2	1.8	2.7	watts	

Notes : 1) Amplitude of sync. signal

2) The back-light power consumption shown above excludes an external inverter.



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4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C \pm 5°C, 50% \pm 20%RH. The specified values are at an approximate distance 50 cm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

Appendix A presents additional information concerning the specified these characteristics.

Table 3 OPTICAL CHARACTERISTICS

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast Ratio	CR	50	-	-		1)
Surface Brightness, white	SB _{WH}	100	120	-	cd/m ²	2)
Brightness Uniformity	SB _U	-	-	2.5		3)
Response Time	T _R				msec	4)
Rising Time	T _{TR}	-	-	30		
Falling Time	T _{TF}	-	-	50		
CIE Color Coordinates						
Red	x _R	0.52	0.55	0.58		
	y _R	0.31	0.34	0.37		
Green	x _G	0.25	0.28	0.31		
	y _G	0.49	0.52	0.55		
Blue	x _B	0.12	0.15	0.18		
	y _B	0.08	0.11	0.14		
White	x _W	0.28	0.31	0.34		
	y _W	0.31	0.34	0.37		
Viewing Angle					degree, °Δ	5)
x axis, right (•≒0°)	•E		45			
x axis, left (•≒180°)	•E		45			
y axis, up (•≒90°)	•E		10			
y axis, down (•≒270°)	•E		30			

Notes : 1) Contrast Ratio (CR) is defined mathematically in window as :

(Surface Brightness with white pixels : 100% IRE)

(Surface Brightness with black pixels : 0 % IRE)

2) Surface brightness is a measurement of the active display area, 50cm from the center of the surface in condition of displaying window pattern.

3) Brightness uniformity is defined mathematically. For more information see Appendix A.

4) Response time is the time required for the display to transition from white to black(Rising Time, T_{TR}) and from black to white (Falling Time, T_{TF}). For additional information see Appendix A.

5) Viewing angle is the angle at which the contrast ratio is greater than 10 with window pattern. The angle are determined for the horizontal or x axis and the vertical y axis with respect to the z axis which is normal to the LCD surface. For more information see Appendix A.

6) Optical characteristics are measured using the following equipments;
photometer is PR880(PHOTO RESEARCH), pattern generator is PM5640A (PHILIPS) .



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5. Interface Connections

The interface connector is a 28pin, that is manufactured by Elco. (# Model : 6200 - 528 - 430- 000)
The electronics interface connector is connected to the FFC.
The pin configuration for the connector is shown in the table below.

Table 4 MODULE CONNECTOR PIN CONFIGURATION

Pin	Symbol	I/O	Description	Notes
1	HSY	O	Internal horizontal sync signal(in phase with V_{BS})	1)
2	VS \bar{Y}	O	Internal vertical sync signal(in phase with V_{BS})	1)
3	NC	-	This shall be electrically opened during operation.	
4	NC	-	This shall be electrically opened during operation.	
5	NC	-	This shall be electrically opened during operation.	
6	CLR	I	Color adjusting terminal	2)
7	BRT	I	Brightness adjusting terminal	2)
8	TNT	I	Tint adjusting terminal	2)
9	CNT	I	Contrast adjusting terminal	2)
10	GND	I	Ground	
11	V_{DS}	I	Composite video signal	3)
12	GND	I	Ground	
13	V_{RI}	I	Color video signal(Red)	4)
14	GND	I	Ground	
15	V_{GI}	I	Color video signal(Green)	4)
16	GND	I	Ground	
17	V_{BI}	I	Color video signal(Blue)	4)
18	GND	I	Ground	
19	YS	I	Super impose	5)
20	V_{SW}	I	Selection signal of Composite or Analog R.G.B	6)
21	NC	I	This shall be electrically opened during operation.	
22	CSY	I	Csync input (As a selection of Analog R.G.B signal)	
23	GND	I	Ground	
24	GND	I	Ground	
25	VEE	I	Positive power supply voltage	
26	NC	-	This shall be electrically opened during operation.	
27	NC	-	This shall be electrically opened during operation.	
28	NC	-	This shall be electrically opened during operation.	

Notes: 1) Negative polarity

2) Brightness, contrast, color gain and tint are adjusted by the DC voltage supplied to each pin. (Contrast, color gain, and tint are not available for RGB signal input.) They are adjusted to the optimum value before shipping but, they can be readjusted by the built-in variable resistor(BRT, CNT, CLR, TNT) or external circuit shown in Appendix D.

3) In case of RGB input, apply composite video signal(V_{BS}) or composite sync signal (c-sync) with negative polarity to the sync separator.

4) Input signal 2

(1) Responsive to 0~0.7 V_{P-P} analog RGB signal when V_{SW} is fixed to "low".

(2) In case of superimposing on composite video signal as on screen display.

RGB signals shall be digital signal.(low : 0 V_{P-P} , high : >2 V_{P-P} available for 8 color display)

5) High : RGB Mode, Low : Video Mode (NTSC)

Interface Connections (cont'd)

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6) Select input signal(composite or standard analog RGB)

- (1) When V_{sw} is "high" or open, composite video signal(Pin No. 11) is selected.
- (2) When V_{sw} is "low", analog RGB signal sets (Pin No. 13, 15, 17) is selected.

Caution : The shielding case is connected to the GND terminal which cuts electrical signals short.

The backlight interface connector is a model BHR-03VS-1, manufactured by JST. The mating connector part number SM02(8.0) B-BHS-1-TB or equivalent. The pin configuration for the connector is shown in the table below

Table5. BACK LIGHT CONNECTOR PIN CONFIGURATION

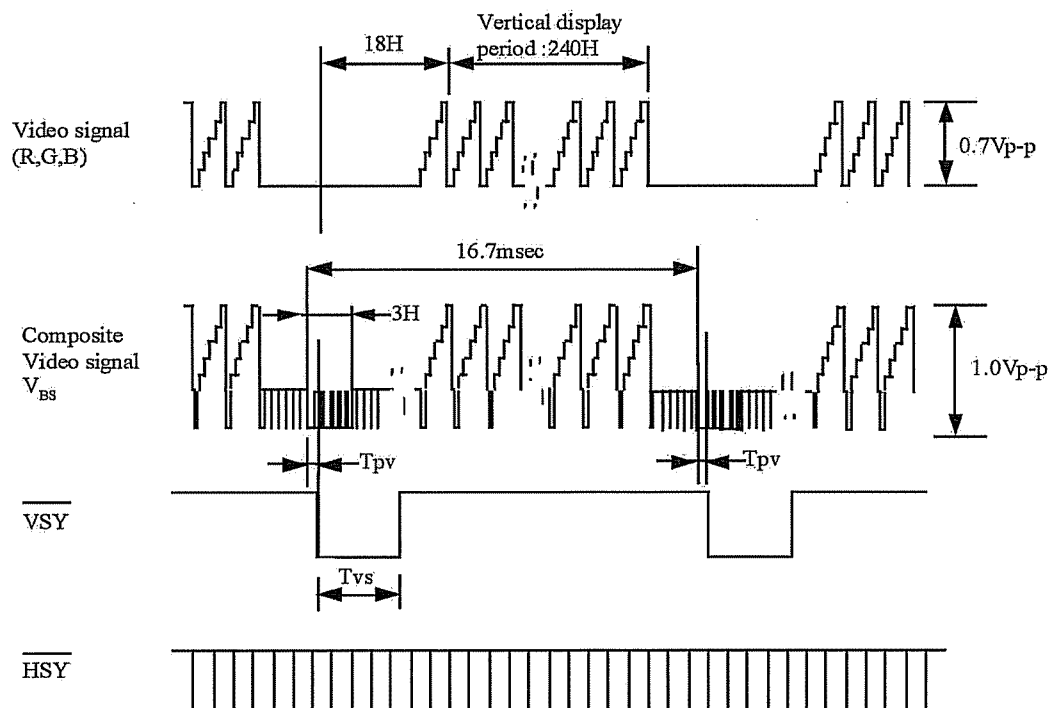
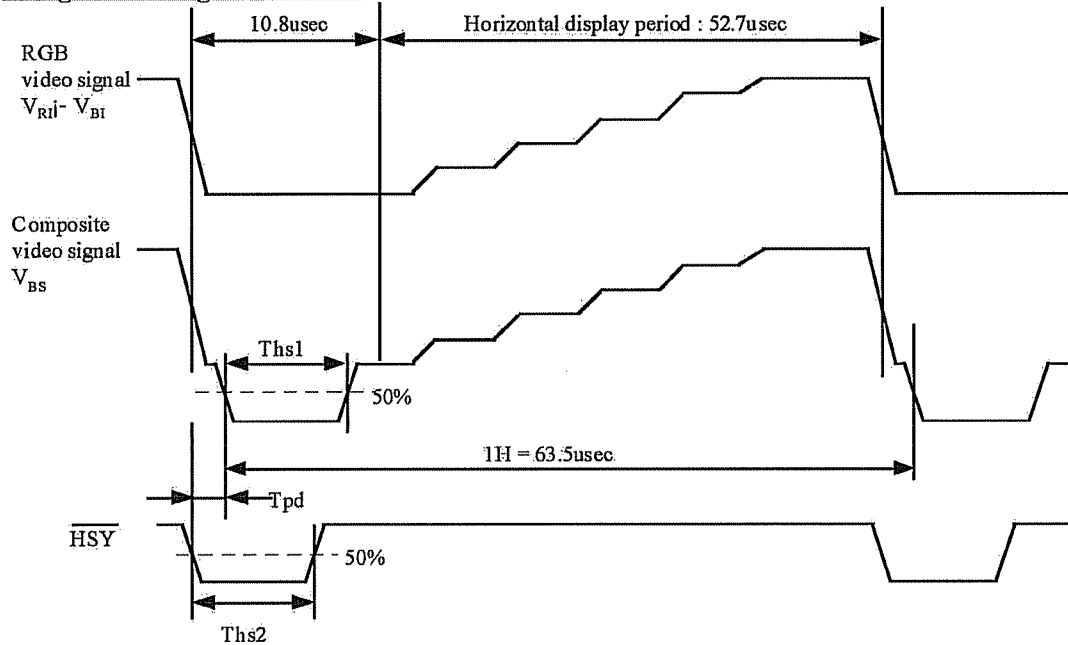
Pin	Symbol	Description	Note
1	HV	Lamp power input	
2	NC	No connection	
3	LV	Ground	

6. Signal Timing Specifications

Parameter		Symbol	Value			Units	Notes
			Min.	Typ.	Max.		
\overline{HSY}	Frequency	f_{HSYNC}	-	15.7	-	kHz	
	High duration	t_{HSYNCH}	-	58.9	-	β_i	
	Low duration	t_{HSYNCL}	-	4.6	-	β_i	
\overline{VSY}	Frequency	f_{VSYNC}	-	60	-	Hz	
	High duration	t_{VSYNCH}	-	16.48	-	msec	
	Low duration	t_{VSYNCL}	-	192	-	β_i	
Horizontal sync.	Input pulse width	T_{hs1}	4.2	4.7	5.7	β_i	
	Output pulse width	T_{hs2}	4.5	5.0	5.5	β_i	
Horizontal sync. phase difference		T_{pd}	-2.0	-	2.0	β_i	
Vertical sync. output pulse		T_{vs}		192		β_i	
Vertical sync. phase difference	odd field	T_{pv}	31	37	43	β_i	
	even field		24	30	36	β_i	



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7. Signal Timing Waveforms




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8. Mechanical Characteristics

The chart below provides general mechanical characteristics for the LC064N1. The C/F's black matrix has CrO_x coating that minimize reflection. The below diagram is a detailed mechanical drawing of the LCD. Note that dimension are given for reference purposes only.

Outside dimensions:	Width	168.0 mm
	Height	123.0 mm
	Thickness	15.5 mm
Active Display area:	Width	130.56 mm
	Height	97.92 mm
	Diagonal	162.6 mm
Viewing area dimension	Width	130.56 mm
	Height	95.472 mm
	Diagonal	161.743 mm
Weight (Typical)		310gram



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9. Reliability test

9.1 Drop test

Conduct the following drop test with the chassis unit and should operate as normal usage without any damage after this test.

Acceleration	:	100G 6ms each °X, °Y, °Z
Secure	:	Screw
Times	:	3

9.2 Vibration test

Conduct the following vibration test with the chassis unit and should operate as normal usage without any damage after this test.

Frequency(Hz)	:	10 to 55
Amplitude	:	1.5m 0.5 Oct/min each X.Y.Z
1 cycle period	:	3 minutes(back and force)
Secure	:	Screw
Time	:	Up/Down: 2 hours
		Forward/Back:
		Right/Left:

9.3 Pressure reduction test

Set up the unit in the pressure reduction chamber and reduce the air pressure gradually from the normal pressure to 510hPa(300mmHg) which is equivalent to 5,000m height. There should have no damage to turn on the unit with 10% increased power for 30 minutes and repeat power on and off for 3 times quickly

9.4 High temperature storage(without power)

Keep the unit in 60° temperature and 50% humidity chamber for 240 hours without power. Take out the unit to make it normal temperature and make sure that the unit has no safety hazard and operate as normal usage without any damage

9.5 Low temperature storage(without power)

Keep the unit in -20° temperature and 0% humidity chamber for 240 hours without power. Take out the unit to make it normal temperature and make sure that the unit has no safety hazard and operate as normal usage without any damage

9.6 Humidity test(with power)

Operate the unit in 40° temperature and 90% humidity chamber for 240 hours with power. Make sure that the unit has no safety hazard and operate as normal usage without any damage

9.7 High temperature test(with power)

Operate the unit in 50° temperature and 50% humidity chamber for 240 hours with power. Make sure that the unit has no safety hazard and operate as normal usage without any damage

9.8 Low temperature test(with power)

Operate the unit in 0° temperature and 0% humidity chamber for 240 hours with power. Make sure that the unit has no safety hazard and operate as normal usage without any damage

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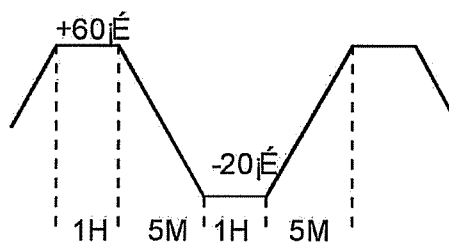
Discharge DC 8kV under non operating to chassis angle for 10 times of 1 second interval with 330 Ω 150pF probe.

Make sure that the unit has operate as normal usage without any damage

9.10 Thermal shock test

Keep the unit in the following temperature chamber without power.

Take out the unit to make it normal temperature and make sure that the unit has no safety hazard and operate as normal usage without any damage.



of Cycle : 30Cycle



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10. Handling precautions

- 10.1 Be sure to turn off the power when connecting or disconnecting circuit.
- 10.2 Note that polarizer are easily damaged, pay attention not to scratch or press these surface with any hard object.
- 10.3 When LCD surface become dirty, please wipe them off with soft material like absorbent cotton
- 10.4 Protect the module from the ESD. As it may damages electronic circuit (C-MOS).
Make certain that treatment person's body are grounded thru wrist band.
- 10.5 Do not disassemble the module and be careful not to have strong mechanical shock such as twist when install to the cabinet. It may cause damage permanently.
- 10.6 Do not leave the module in high temperature, especially in high humidity for a long time.
- 10.7 Store the module not to expose to the sunlight directly.
- 10.8 Avoid condensation of water. It may cause misoperation.



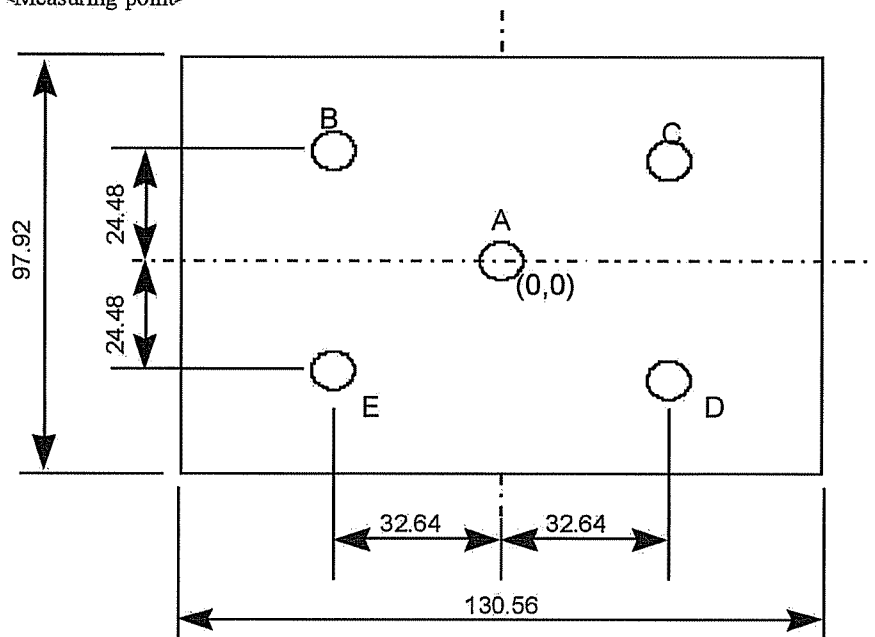
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(Appendix A)

A.1 BRIGHTNESS UNIFORMITY

<Measuring point>

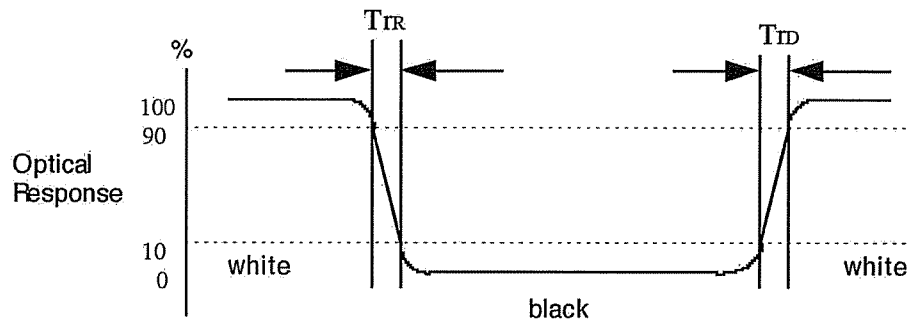


unit : mm

$$\text{Brightness Uniformity} = \frac{\text{Max}}{\text{Min}} = 1.42$$

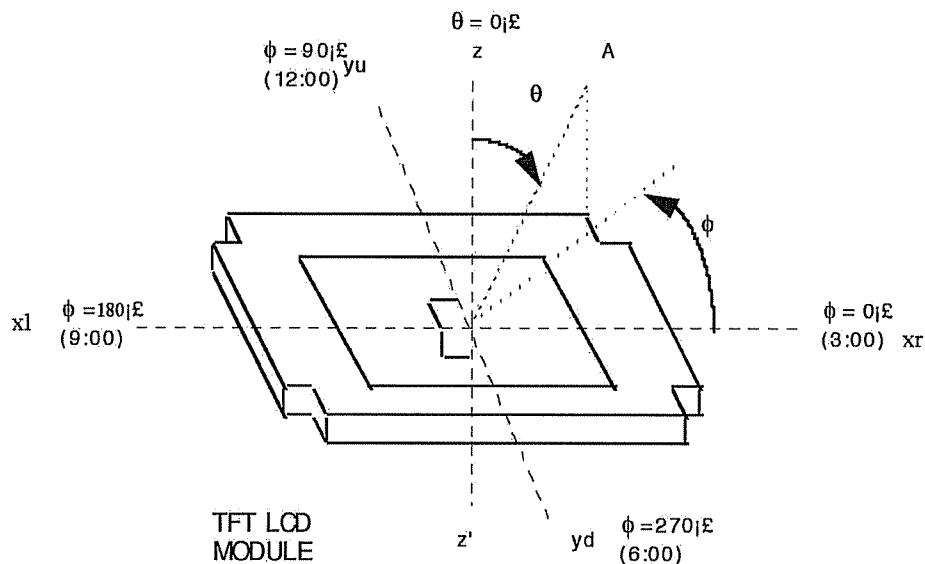
A.2 RESPONSE TIME

The response time is defined according to the below diagram and is measured by time needed to switch the input signal for "black" and "white".



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(Appendix A)
A.3 VIEWING ANGLE

Viewing angle is defined according to the below diagram.



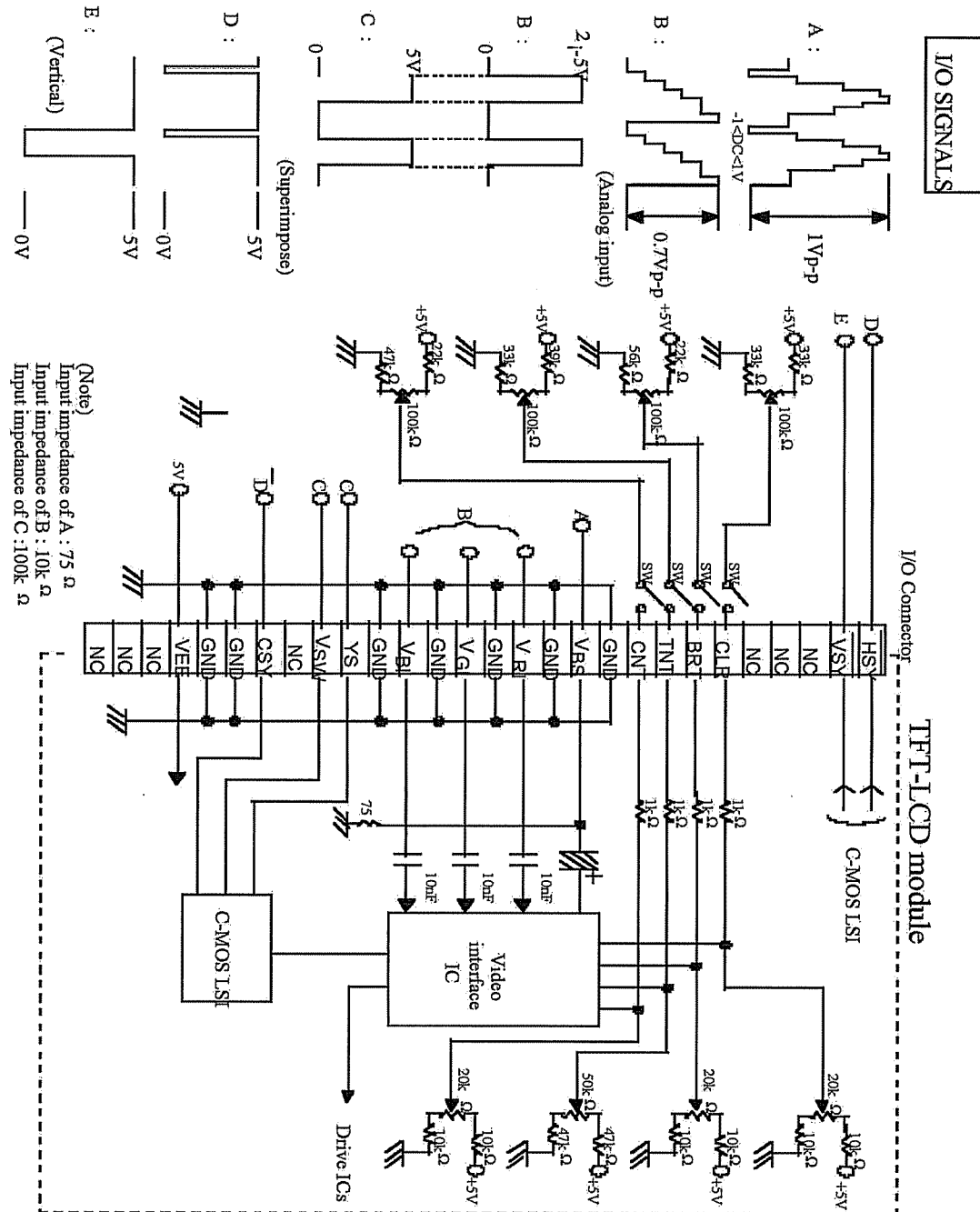


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(Appendix B)

B. Recommended circuitry



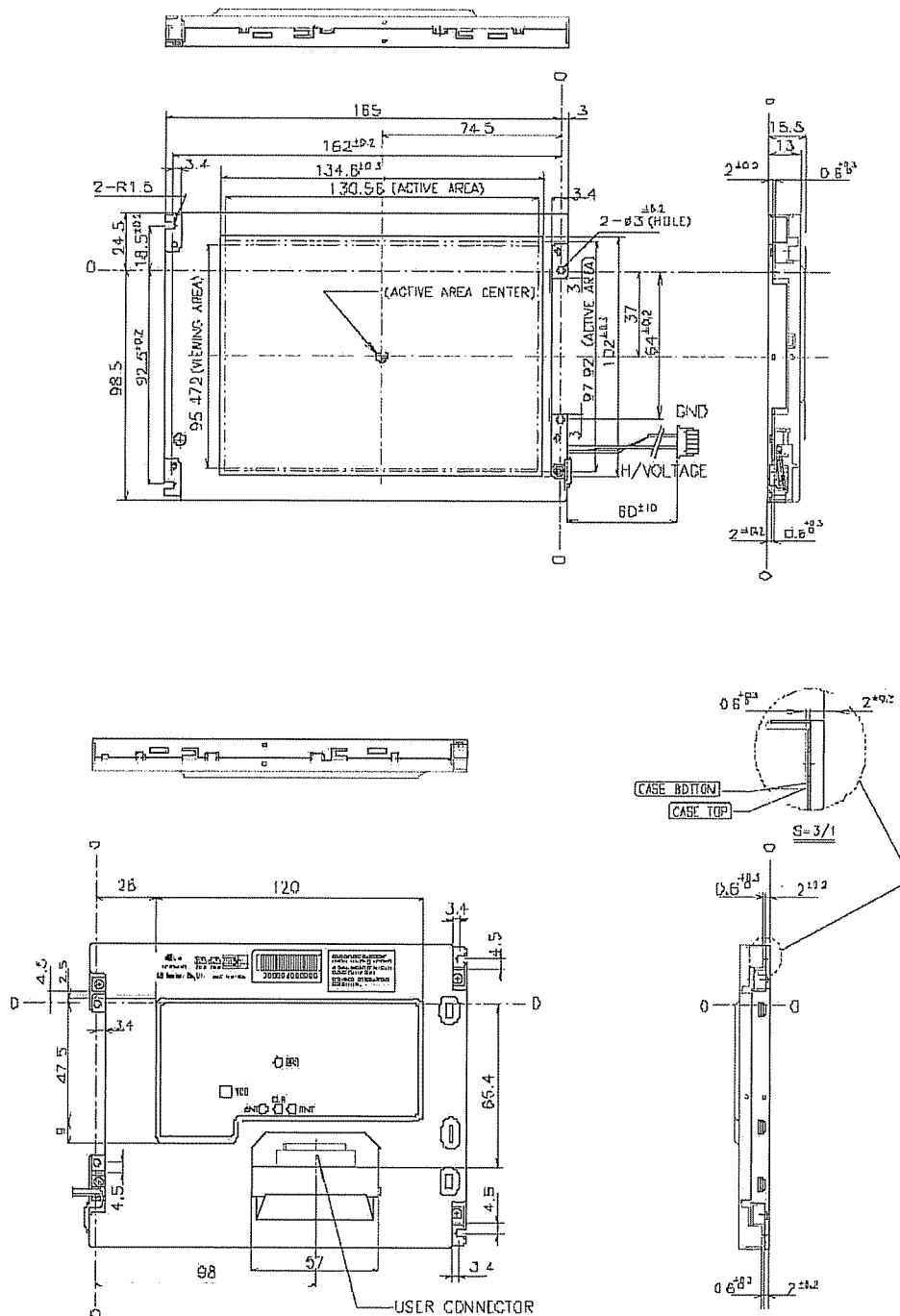


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12. Drawing



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